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OPTIMAL ADVERTISING:  
ADSTOCK AND BEYOND

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## ABSTRACT

Decision-makers are frequently exhorted to employ 'scientific' budgeting techniques based on the marginal logic of formal economic analysis; some have claimed success in this regard. Yet survey data continue to reveal that most managers in practice use various combinations of ad hoc and, at best, quasi-systematic methods of budget determination. This paper examines the theoretical basis of the prescribed marginal approach and argues that it is generally incapable of implementation given unresolved specification problems in the incorporation of measures of cumulative advertising effect and the behavioural definition of the advertising process.

## INTRODUCTION

The possibility of optimizing advertising expenditures and returns has long acted as a spur to promotional research. Interest in the optimality of advertising derives from a variety of motivations but primarily from the search for an ideal method of setting advertising budgets, the most productive allocation of media budgets over different vehicles, and the determination of the optimal level of advertising in the economy. In each case, the logic of optimality is more easily conceived than implemented, though inevitably the ability to conceive of optima at all is related to the availability of appropriate mathematical/statistical technique.

The goal of optimality is, nevertheless, widely commended to potential and current managers. As Hooley and Lynch (1985, pp.223-4) note, 'The major advertising textbooks follow a similar pattern in that they tend to advocate logical and rational methods of budget-setting ... as the nearest workable approximation to the ideal marginal model of economic theory; (italics supplied). And Simon (1984, p.321) points out that 'The most important decision in advertising ... is still usually decided in pre-scientific ways ... [I]t is time for businessmen to move towards a more scientific practice in setting advertising budgets'. (Cf. Driver and Foxall 1986).

However, this continuing interest in the possibility of using marginal analysis in the search for the optimal advertising budget appears to have had little direct impact on business practices. Whilst there is some evidence that advertisers have increasingly preferred to adopt methods which have some basis in logic and that the gap between theory and practice is slowly closing, there remains the significant finding in the recent survey of UK advertisers' behaviour that more sophisticated procedures correlate with higher profitability (Hooley and Lynch 1985). Accordingly, Hooley and Lynch perceive

a 'massive obstacle' between theory and practice being partially dismantled as particularly large advertisers appreciate the benefits of more rational budgetting. Moreover, the increasing interest in research into advertising effectiveness by some advertising agencies and a general move among researchers from qualitative to quantitative methods make appraisal of the marginalist approach to budgetting timely.

This paper discusses the way in which the marginal theory and its associated empirical implications have been made operational by the advertising community. It addresses the broad question of whether the model can be implemented by advertisers to achieve an optimal allocation of advertising spending, particularly through time. Specifically, it is concerned with the prescriptive implications of this coherent and largely self-contained theory and omits consideration of other ways in which optimization through the incremental adjustment to evolving experimental methods might be employed in the management of advertising.

## OPTIMAL ADVERTISING

Both theoreticians and practitioners have devoted considerable effort to the analysis of advertising expenditure with the objective of optimising profit. Thus optimal advertising is (usually) conceived in terms of the sales revenue inducing effect on the one hand and its cost on the other. Maximum profit is achieved when the marginal revenue stemming from advertising is just equal to the marginal cost incurred in advertising; at lower levels of advertising some revenue-inducing potential would be forgone whilst, if the marginal cost of advertising exceeds the revenue accruing from it, the advertising expenditure would be 'wasted' and better allocated elsewhere. This marginalist logic has been the underlying principle in the development of a number of theoretical models specifying the rules of optimal advertising expenditure. These rules

are derived from the analysis of carefully specified situations of increasing complexity following the initial work by Dorfman and Steiner (1954; see also Ramussen 1952).

Dorfman and Steiner considered the profit-maximising advertising expenditure for a monopolist under static conditions of known demand. Specifying the demand function ( $Q$ ) in terms of price ( $P$ ) and advertising ( $A$ ):  $Q=Q(P,A)$ , the rules for the optimal advertising expenditure may be expressed in either of two ways:

1. Advertising should be increased to the point where its marginal sales effectiveness equals the price elasticity of demand ( $e$ )

$$P \frac{\partial Q}{\partial A} = e$$

2. The advertising sales ratio should equal the ratio of advertising elasticity of demand ( $a$ ) to the price elasticity of demand ( $e$ )

$$\frac{A}{PQ} = \frac{a}{e}$$

$$\text{where } a = \frac{\partial Q}{\partial A} \cdot \frac{A}{Q} \quad \text{and} \quad e = -\frac{\partial Q}{\partial P} \cdot \frac{P}{Q}$$

More elaborate models allowing variously and in combination for the effects of advertising and price over time and the responses of competitors have been constructed

by Nerlove and Arrow (1962), Schmalensee (1972), and by Cowling et al.(1975) From these models, the profit maximising rules show remarkable similarity to rule (2) above if advertising and price elasticities are appropriately defined. Thus, what might be called the generic Dorfman-Steiner rules state that optimum advertising requires that the advertising sales ratio should equal the ratio of (adjusted) advertising and price elasticities of demand. Indeed this basic form is appropriate for the maximisation of managerial utility (Peel 1973) and market share (Lambin 1970). The comparative simplicity of these theoretical rules and their superficial conformity with the widely-practised rule of thumb methods of setting advertising appropriations as a percentage of sales has led to many attempts to 'apply' the above theories to empirical situations. Indeed, the formulation of some of the theoretical specifications leading to the generic Dorfman-Steiner rules were guided by the desire to achieve greater realism in the way advertising affects sales and in modelling the competitive context in which advertising decisions occur.

An early cautionary note was, however, forwarded by Dorfman and Steiner (1954, p.836):

'There are good grounds for doubting the economic significance of the whole business of writing down profit functions (or drawing curves) and finding points of zero partial derivatives (or graphical points of tangency). Such devices are merely aids to thinking about practical problems and it may be an uneconomical expenditure of effort to devote too much ingenuity to developing them. Yet such devices are aids to clear thought and, if sufficiently simple and flexible, they help us find implications, interrelationships, and sometimes contradictions which might escape notice without them.'

In investigating the significance of the generic Dorfman-Steiner rules beyond the confines of purely theoretical perspective, it is necessary to consider the nature of the tests of the theory and its subsequent performance. This involves matters of some complexity, especially where different criteria support differing conclusions and where the trade-offs between such criteria involve fine judgement. Nevertheless, because the generic Dorfman-Steiner rules and their associated empirical procedures have been frequently advocated for the determination of optimal advertising expenditures (by advertising researchers, agencies, managerial economists and marketers, e.g. Dhalla 1978, and Broadbent (1980)), for primarily commercial purposes it is appropriate to consider the issues in some detail.

#### Assumptions

The objective of profit maximisation is an explicit assumption of the models but in the various specifications the nature of the included and omitted variables, the treatment of time and the conception of consumers' behaviour, the competitive and organisational context, all involve additional assumptions many of which are implicit. Obviously, the various models that comprise the generic category exhibit different attributes but some general features may nevertheless be discerned. To include advertising in expenditure form is to treat it homogeneously and this is no less the case with treatments which distinguish messages from expenditures and therefore allow for the price but not the content of advertisements - see Schmalensee (1972) - but to disregard the nature of advertising copy is critical. The models also typically assume that there is a costless optimisation of advertising expenditure over media and time.

A certain determinism in the way advertising leads to sales revenues is implied - it is as if the mere act of buying advertising buys customers, rather than the advertising messages in their qualitative aspects contributing to purchase behaviour in a variety of ways through different and vicarious mechanisms. Formulations in aggregate objective terms are unable to capture the essential subjectivity of advertising reception, thus the use of an objective quantity concept denies the fusion of that reception with the physical product itself so to form a composite which is the actual entity purchased when advertising has had an effect.

The formulations showing advertising in monetary terms with an objective product definition are better suited to the analysis of advertising purely as information and thus separate from the product purchase decision in both time and cost dimensions (see Driver and Foxall 1984, chapters 2 and 3), but they are in keeping with their genesis to the extent that econometrics is based on economic theory. On the other hand, lack of specificity in the way advertising expenditure leads to sales permits the possibility of any acceptable composite arising from the conjunction of advertising and the physical product but this, of course, begs the question of the formulation of the appropriate copy and the management of advertising to achieve such effects in the first instance.

In a further respect, however, the representation of advertising in expenditure terms alone may be appropriate. Thus where a manufacturer gives advertising support to a product to establish its 'credibility' in the eyes of the consuming public and more especially in relation to the purchasing decisions of distributors, the amount of expenditure rather than the way in which (within broad limits) that expenditure is actually spent is the significant point of advertising. Most applications of the generic Dorfman-Steiner models, however, omit consideration of the behaviour of distributors

and are conceived in terms of final demand only. Even in those cases where a distribution parameter is included in the analysis (Kotler 1971, chapter 3), the effect envisaged is of distribution expenditure on the consumer rather than of distributors' behaviour per se. Distributive characteristics, somewhat belatedly, are also gaining recognition in economics literature, at least in distinguishing broad categories of copy; thus retailers' advertising is seen as broadly informative with manufacturers' being persuasive (e.g. Boyer 1974) and indirectly the different advertising sales ratios associated with different products are recognised as indicative of alternative marketing characteristics (including channels of distribution) rather than purely the outcome of market power (e.g. Porter 1974).

In studies which involve many brands in a product class (e.g. Broadbent and Colman 1986), the observation that distribution is 'uniformly high' - it is maintained - enables distribution explanata to be omitted, an expedient that matches the inability of regression techniques to ascertain effects where there is an absence of variation. However, the qualitative effects of advertising and other promotional activity are hardly irrelevant (at whatever level the distribution happens to be) to distributors' decisions and behaviour, both directly in terms of complementary communication via the salesforce and point-of-sale promotions and indirectly in terms of the presumed attractiveness and impact of the advertisements on consumers and the potential reactions of competitors.

### Time Considerations

The models which incorporate some adjustment process of demand to advertising over time recognise a variety of features of both advertising and consumers' behavioural patterns. For instance:

1. Advertising must cumulate over time to reach thresholds of effectiveness.
2. Current advertising recipients are not necessarily current consumers, the advertising influence will occur later.
3. Advertising inculcates habits which further advertising maintains.
4. Advertising is subject to obsolescence and wear-out and needs renewal.

Despite this variety, the methods used to incorporate time effects do not distinguish between these various features although in principle they could do. Rather, the recognition of time effects is used to support the proposition that advertising expenditures should be regarded in terms of investment principles and expressed in dynamic formulations. The influential approach by Nerlove and Arrow (1962) conceives that current advertising contributes to a stock of advertising influence - goodwill - which is a determinant of sales. Current advertising can increase the stock of goodwill or maintain its level given that it depreciates at a constant rate. To maximise profits the appropriate levels and paths of both price and advertising must be determined, which depends on the certain response of consumers and constancy of the interest rate on advertising funds. It may be shown that the optimal advertising to sales ratio is a function of appropriately adjusted elasticities of advertising and price and the

instantaneously optimal policy is the dynamic counterpart of the Dorfman-Steiner theorem, a result which depends on the assumption that the stock of goodwill can be maintained at constant cost. Nerlove and Arrow themselves consider this 'is actually very unrealistic' since at high levels of advertising expenditure there must be resort to inferior media etc. which must raise the cost of maintaining goodwill. The Nerlove and Arrow conception of a depreciating stock of goodwill dependent on the current and past levels of advertising outlays, adjusted in conformity with current sales, is equivalent to a Koyck type of distributive lag model where current advertising depends on current sales and the advertising in the preceding period alone (see Koutsoyiannis 1982, pp.113-114).

The properties of the Koyck system, to enable the truncation of a possibly long prior sequence of influences on current events, have been especially prized by empirical researchers. In the case of advertising, if the effects of previous advertising on current sales could be assumed to be declining geometrically, then the current and past effects of advertising on sales could be distinguished and (subject to further considerations) empirically determined. Indeed, the utilisation of such a distributive lag system in conjunction with the Dorfman-Steiner theorem in a pioneering study by Palda (1964) set a basic methodology for the establishment of optimal advertising policy which, because of its importance, is considered in more detail below.

Where time is recognised as an important component in models of optimal advertising determination and especially in empirical work, it is appropriate that separate functions should describe how advertisers respond to unfolding events and how advertising influences consumer demand. If advertising influences sales which in turn contribute to the advertising decision then a simultaneous equation system is indicated. Certainly, where there is an underlying simultaneous system, attempts to estimate the parameters of a single equation model by ordinary least squares are likely to yield biased

and inconsistent estimates of the coefficients. This has prompted some attempts to employ simultaneous equation estimation techniques in the acquisition of price and advertising elasticities, but a conspicuous overall superiority of such models has not been demonstrated and despite its theoretical limitations the single equation mode continues to predominate. This in part accounts for the tendency of most studies to be concerned with the effects of advertising on demand and to take the level of advertising as given, a posture which ignores producer decision-making. Interest then centres on whether the level is appropriate for optimal profit. This indeed with the approach adopted by Palda, whose data on the Lydia Pikham Company have, incidentally, been extensively re-analysed in the quest for a more refined estimation procedure.

#### Adstock

Much of the recent work on the estimation of the time characteristics of advertising has employed the idea of an adstock (Broadbent 1979). This concept, closely related to Nerlove and Arrow's (1962) notion of goodwill or advertising capital, cumulates multi-period advertisements into a single quantity. It is seen as a first stage in testing the efficacy of advertising content and management because any variety in sales effectiveness may then be attributable to different advertising decisions. In specifying the advertising in terms of TVRs or equivalent measures of communication effect, it is hoped to remove from the analysis the contaminating influence of marketing and other factors on sales. Our discussion will return to these ideas.

#### Assessing Optimal Advertising Expenditures

The general Dorfman-Steiner rules for optimal advertising depend on empirical estimates of the appropriate parameters derived from regression analysis. But a

simplified specification of the relationships from which the parameter estimates that are necessary to make the general Dorfman-Steiner rules operational is given below. This provides a basis for subsequent discussion on the efficacy of this approach to optimal budgeting, though our simplification omits detailed econometric considerations. As noted above, Palda employed the Koyck distributive lag system whereby the effect of previous advertising on current sales geometrically declines by a factor  $(0 < \lambda < 1)$ , the further in the past that advertising expenditure occurred. Thus

$$S_t = a_0 + a_1 A_t + a_1 \lambda A_{t-1} + a_1 \lambda^2 A_{t-2} + a_1 \lambda^3 A_{t-3} + \dots$$

and lagging by one period and multiplying by  $\lambda$

$$\lambda S_{t-1} = a_0 \lambda + a_1 \lambda A_{t-1} + a_1 \lambda^2 A_{t-2} \dots$$

Finding  $S_t - \lambda S_{t-1}$  and re-arranging

$$S_t = a_0(1 - \lambda) + a_1 A_t + \lambda S_{t-1} \quad (1)$$

In effect the entire set of previous advertising influences is summarised in the

$\lambda S_{t-1}$  term — the lagged dependent variable — in (1).

From (1) the short run and long run marginal sales effectiveness of advertising may be obtained.

$$\text{SRMSE} = \frac{dS_t}{dA_t} = a_1$$

$$\text{LRMSE} = \sum_{t=0}^{\infty} a_1 \lambda^t = \frac{a_1}{1 - \lambda}$$

As stated above, the Dorfman-Steiner result gives as the condition for optimal advertising that the marginal sales effectiveness of advertising should equal the price elasticity of demand, that is  $MSE=e$ .

Palda did not have direct estimates of (e) for Pinkham's but employing the theoretical proposition that it is irrational for a profit-maximising monopolist to produce where  $e < 1$  ( $MR < 0$ ) it could therefore be deduced that only LRMSE was compatible with profit maximisation since  $SRMSE < 1$  and  $LRMSE > 1$ . Some corroboration of this interpretation is obtained from application of the proposition that an optimal pricing policy has the mark-up equal to the reciprocal of (e) and in Pinkham's case this approximately equated with LRMSE. Thus assuming that optimal pricing was employed, optimal advertising was also achieved. The consistency of these deductions enabled some confidence to be placed in the parameter estimates (in addition to econometric justification) - especially in the estimates of MSE and  $\lambda$ . Indeed, by knowledge of these estimates and the mark-up (c) the marginal rate of return on advertising investment (r) may be calculated.

$$r = \frac{ca_1 + \lambda - 1}{1 - ca_1}$$

and by considering a proportion (x%) of the total sales-generating capacity of advertising the x% life of advertising may be deduced. That is, the time (t) for advertising to exhaust x% of its effect is

$$\frac{S(t)}{S(\infty)} = x$$

where  $S(t)$  is the sum of the geometric progression of MSE terms for  $(t)$  periods and  $S(\infty)$  is its sum to infinity. (In Pinkham's case the 95 per cent life of advertising was approximately 7 years - from  $.05 = 1 - \lambda^t$ .)

In this study, Palda essentially accepted the validity of the Dorfman-Steiner theory which he then applied and this confirmed his acceptance, because a coherent set of economically acceptable estimates were obtained which found some further theoretical corroboration. On this basis the theory was not subjected to definitive test and although dozens of studies employed Palda's basic methodology (with varying success), there are a number of qualifications which do limit its application to the determination of the optimal budget.

#### Specification problems

Earlier mention has been made of the theoretical requirement for the function which shows the relationship of sales to advertising expenditure to be compatible with the way in which advertising is determined. Advertising is not exogeneously determined but reflects the decisions of management. Where there is a simultaneous relationship between sales and advertising then the advertising function must be specified as well. In the case of the Pinkham's data, Schmalensee (1972, pp.12-13) investigated the variability of the rate of return implied by the parameter estimates in Palda's equation and concluded from their erratic pattern that:

'Clearly, either Pinkham's management did not view the firm's demand function as Palda described it, or they behaved in consistent yet irrational manner for over half a century.'

Thus the original Palda equation judged on the basis of certain econometric tests and its compatibility with the Dorfman-Steiner theory is found wanting against a different test of its efficacy. Moreover, subsequently other criticisms and inconsistencies have become apparent.

Some insight into the issues involved may be seen if we consider the following illustrative specification.

$$S_t = k + bA_t + \rho S_{t-1} + cA_{t-1} \quad (2)$$

Depending on the values of the parameters this specification can represent quite different versions of the advertising sales relationship. For instance

1. If  $c=0$  the specification is equivalent to (1) and may depict the Koyck-type distributed lag advertising pattern.
2. If  $b=c=0$  current and immediately prior advertising have no discernible effect on sales. If  $b>0$  and  $c=0$  only current advertising affects sales and  $MSE=b$ . In either case the  $\rho S_{t-1}$  term may be interpreted as an adjustment of previous sales without any advertising implication.
3. If  $c=-\rho b$  it is implied that advertising has *only* current effects. This may be seen by presuming  $S_t = k + bA_t$  and by lagging and multiplying by  $\rho$ ,  $\rho S_{t-1} = k\rho + b\rho A_{t-1}$  which on substitution in (2) leaves sales equal to a constant plus the current effects of advertising.

In fact several more versions can be obtained from (2) and these and a discussion of econometric considerations are to be found in Clarke (1976) and Weiss and Windal (1980). It was Clarke who raised questions on whether the cumulative effects methodology employed initially by Palda but adopted subsequently by others was in fact giving spurious results. Clarke noticed that the estimates of the coefficient of the lagged sales variable, for data intervals of different durations, gave inconsistent results for the life of advertising. Thus in the Pinkham's case and in others the implied life of advertising was greater when annual data rather than monthly or quarterly data was employed although, of course, as a matter of arithmetic the estimates should tally. From a review of dozens of studies he concluded that the 'duration intervals derived from annual models are too long'; indeed, he (1976, p.357) found that:

'the average implied duration interval derived from annual data is more than 17 times as long as the implied duration interval derived from monthly data'.

For frequently-bought consumer goods the 90 per cent life of advertising was estimated to be between three and nine months. This in turn suggests that at least in terms of annual data a current effects model is appropriate and indeed Clarke found some evidence supporting the interpretation in 3 above. Whilst the question of data interval bias must be recognised some of the conclusions reached by Clarke - especially in the case of the Pinkham's data - have been challenged by Weiss and Windal (1980), who find counter evidence on the basis of revised estimation techniques for the retention of some cumulative effects of advertising.

The question of whether a current effects or a cumulative effects model is adopted is, however, crucial to a test of the optimality of advertising employing the Dorfman-Steiner results. As shown above, the estimates of SRMSE and LRMSE differ

only by a factor of  $\frac{1}{1-\lambda}$  but if  $\lambda$  does not refer to a distribution of lagged advertising effects, the utilisation of  $\lambda$  for such a purpose is improper and the calculations of rate of return, advertising durability etc. are invalid. Moreover, the Dorfman-Steiner result, when appropriate, indicates for  $MSE > e$  that both price and advertising should be increased and for  $MSE < e$  that both variables should be decreased for greater profit. Clearly if the estimates employed are deficient, prescriptions counter productive to the profit objective would be indicated. Whilst this can occur because of the interpretation of advertising-related parameters, a similar problem can arise from imprecision of estimates of the price elasticity of demand. Palda's study of the Pinkham's data was by no means exceptional in deducing the value of  $e$  on the assumption that optimal pricing was conducted. (Why optimal price should be presumed as a basis for the assessment of advertising policy rather than vice versa is a moot point). Ideally, estimates of  $(e)$  that are compatible with advertising estimates and refer to particular time periods on a commensurate basis in terms of lag structures are required.

Typically, however, difficulties do arise due to specification problems, data availability or limitations of estimation technique. The net result according to Scheidell (1978, p.55) is that:

'Very few empirical studies of advertising are designed to estimate demand as a function of price and advertising and none is in a form that specifies the relation between advertising and long run elasticities.'

Scheidell (1978, p.17) contributes a further point of reservation concerning the indication of a price or advertising change based on the Dorfman-Steiner condition, when he argues that application of the static prescription can lead to a result opposite to the one intended if there are lags in consumers' response to a change in price. Thus where a reduced price is indicated to increase profits, although this result will eventually

ensue, in the shorter term there can be losses as the expected increase in sales has yet to materialise whilst existing sales are less profitable than hitherto. Such consideration should bias the firm towards the smaller price reduction.

‘Also, if the demand is sufficiently large, it should bias the firm towards price increases, when static analysis would otherwise suggest the price decrease.’

## DISCUSSION

The theoretical analysis of optimal budgeting yields a number of results expressing the optimal advertising expenditure as a proportion of sales in terms of appropriately defined advertising and price elasticities of demand - this theory is specified for a range of competitive conditions and time periods. The theory has possible applications in two principal directions. First, it may be employed by the advertiser to check the optimality of previous advertising as a guide to improved decisions in the future. Secondly, such an analysis of private profitability, where perhaps ‘excessive’ advertising is demonstrated, can prove of interest to economic regulators concerned on the public’s behalf with the allocation of resources. Furthermore, to the extent that a generalised experience of brand and product elasticities is acquired by the replication of the technique for a variety of different advertising themes, then the inherent inability of the models to portray qualitative effects is mitigated to some degree (although the incorporation of dummy variables to capture the effects of advertising copy or media changes has occurred in some cases). Of course, even the perfect understanding of the past is of uncertain efficacy as a guide to future behaviour and for a large number of reasons the methodology described above falls short of such a standard.

Crucially, the isolation of advertising's effect from other influences on sales must be established. In the absence of experimental control the task is to untangle, by multi-variate statistical methods, the various contributions of those variables thought to be operative. The Pinkham's case was particularly simple in this respect because advertising was predominantly used: nevertheless specification problems concerning the contribution of variables still arose. In general, because of the complexity of short term influences, longer period analyses are favoured to reduce the 'noise' of miscellaneous influences, so that salient features may be seen in greater focus. This is admirable where the phenomena to be analysed can naturally be partitioned in such a fashion, but in the case of advertising this is often not the case as shown by Clarke. Qualitative changes in copy, media allocations and audience characteristics are frequent, with intervals to be measured in weeks rather than years, and what the analyst may wish to classify as 'noise' may be the essential phenomena integral to the analysis. In effect, there is a distinct possibility that the analyses are conducted at too general a level, disproportionate to the complexity of the phenomena to which they refer, e.g. the characteristics of advertising are subsumed in advertising expenditure, the period of influence is arbitrarily imposed, competitive advertising is merely expenditure, etc. The application of such methods to shorter periods is in turn impeded by the acquisition of appropriate data involving the structure and co-operation of distribution channels, where the sheer scale of operations is relevant to this. Yet the choice of period for the analysis data is fundamental to the application of the relevant theory, and the evolving experience from the intensive analysis of particular sets of data (Pinkham's, for instance) shows that the application of the methodology to any new set is inherently problematic. Certainly, the apparent simplicity and plausibility of the theory are compromised by the considerable difficulty and complexity of implementing it and interpreting the results. Moreover, it is still debated whether the Pinkham's data are consistent with the pursuit or the achievement of optimal advertising at least 20 years from the initial investigation. The essential

technical characteristics of this debate must be set against the purposes which initially inspired it: the quest for optimal advertising budgets. The apparent theoretical endorsement of the advertising sales ratio has been cited as a justification for the rules of thumb method widely employed (Schmalensee 1972; Broadbent 1980). This is merely incidental when so much imprecision attends the conceptualisation and determination of the relevant price and advertising elasticities, and where these are unlikely to be constant in the face of evolving market competitive conditions. Inevitably, advertising expenditure can be expressed as a proportion of sales but whether that ratio is optimal is dependent on a wider knowledge than the above methodology encompasses and, in general, the fundamental impediment to the determination of optimal advertising remains the familiar one of the lack of an adequate conceptualisation of how advertising works.

#### Adstock and Beyond

Recent attempts to quantify advertising effectiveness have tended to de-emphasise the budgeting issue whilst retaining many of the assumptions and approaches discussed above. This is particularly apparent from the retention of the notion that advertising should have cumulative effects (incorporated via the previously-mentioned concept of adstock: Broadbent 1979, 1984; Broadbent and Colman 1986) and the use of the idea of the life (usually the half-life) of advertising. These approaches feature weekly or monthly data and so do match more closely the reality of advertising campaigns, but the resulting models tend to concentrate on advertising to the general exclusion of other elements of the marketing mix.

An exception is found in the work of Croome and Horsfall (1983) where a range of marketing variables is initially considered. On the basis, however, that only

small gains in the multiple correlation coefficient in relation to sales (which increases from 0.842 for adstock alone to 0.897 and 0.903 for price, and price plus distribution terms, respectively) stem from the inclusion of these terms, the authors find significant justification for omitting these non-advertising variables. This may appear superficially reasonable but it can be argued that there is, at best, an inconsistency where differences of smaller magnitude in the correlation coefficient are necessary to justify the treatment of the half-life of adstock in a way that permits any interpretation other than that of current effects (i.e. that there is effectively no carry-over of advertising). Where the issue is whether there are cumulative effects of advertising, it is necessary that the model should provide a means of unambiguously demonstrating this fact. The assumption of cumulative effects and the adoption of procedures to present this assumption in the most favourable light should only be predicated on its prior ascertainment.

In a recent application and test of the Broadbent adstock model, the relevant estimating equation derived by Jex (1985, p.294) is identical to (1) above. Moreover, for his data, Jex also demonstrates, on econometric grounds, that equation (1) is the preferred form among the available estimation possibilities. It follows from our previous discussion that equation (2) above is also relevant and that it provides in particular the insight that, to isolate the effectiveness of advertising when using the lagged dependent variable, there must be an assurance that the model is not just tracking sales rather than advertising effects,

In the study by Jex, the relevant dependent variable (Broadbent's 'awareness') is actually a behavioural indicator since it refers to average daily applications in response to an advertising campaign. His example is, furthermore, of a one-off 'purchase': only a single application to open a bank account can be expected of a customer regardless of

advertising levels. 'Awareness' is, therefore, unambiguous precisely because it is specified as a unique behaviour. Given this, Jex's finding that the model is not spuriously based on auto-correlated input variables - specifically, the lagged 'awareness' term representing the behaviour of other applicants - is hardly surprising. Incidentally, the half-life of the relevant advertisements is approximately two and a half weeks: a period short enough to nullify the investment implications of advertising for a particular campaign.

Such separation of the time effects of advertising reponse from overt behaviour is not so easily achieved in the case of the typical fast-moving consumer good which is characterised by both repeat advertising and repeat purchasing. Indeed, in this case, advertising and repeated purchasing are contemporaneous. If a model which purports to explain communication as awareness in terms of cumulative advertising is equivalently specified in terms of variables which represent sales behaviour, then the contribution of advertising as distinct from that of other factors is difficult, perhaps impossible, to sustain.

It certainly appears that the specification problems of the type discussed above are being underestimated in current attempts to estimate advertising effectiveness. More importantly in view of the trend towards a more behavioural explanation of marketing phenomena (Foxall 1983, 1986; Nord and Peter 1980), the strong possibility that it is the cumulative sales experience that accounts for both increased awareness and purchase cannot be ruled out. Clearly, many issues require resolution before advertising budgeting can be optimised in any sense of the word.

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